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PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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MISSOURI - MUSSELSHELL BASIN
LEBO LAKE AND DAMS
WHEATLAND COUNTY, MONTANA
MT-72 (NORTHWEST DAM)
MT- 653 (NORTHEAST DAM)
MT-73 (EAST DAM)

PREPARED FOR:

HONORABLE THOMAS L. JUDGE
GOVERNOR, STATE OF MONTANA

AMERICAN FORK RANCH
GLENNIE RANCHES
(OWNERS)

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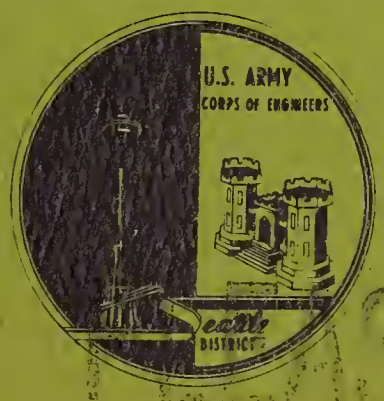

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EXECUTIVE SUMMARY

Under contract with the Seattle District Corps of Engineers and with representation from the State of Montana Department of Natural Resources and Conservation and the owners, the three dams at Lebo Lake were inspected by Hoskins-Western-Sonderegger, Inc., on 8 May 1979, under the authority of Public Law 92-367. Lebo Lake is located in Wheatland County, Montana, approximately 8 miles south of Two Dot, Montana.

This report was compiled from information obtained during an on-site inspection, an interview with the owners, a review of existing plans, and analysis of hydrologic and hydraulic data. Findings were compared to engineering criteria currently accepted by most private and public agencies engaged in dam design, construction, and operation.

PRINCIPAL FINDINGS AND EVALUATIONS

Lebo Lake, owned and operated by the American Fork Ranch and the Glennie Ranches, is used for irrigation, recreation, and stock watering. The project consists of a natural lake and three embankment dams to raise the lake elevation for additional storage. A series of diversion canals carries water to the lake from several creeks to the south and west of the lake. The reservoir has a drainage area of 2.7 sq mi, a surface area of about 413 acres at normal pool, and total storage at the minimum crest elevation of the three dams (4922.2 feet for Dam 2) of 4735 acre-feet.

In accordance with the "Recommended Guidelines for Safety Inspection of Dams" (Ref. 1), the 8-foot-high Lebo Dam 1 (northwest dam, MT-72), impounding approximately 2835 acre-feet, is classified as being of intermediate size. The downstream hazard potential classification of Dam 1 is high (Category 1), due to the presence of more than 2 inhabitable structures below the dam. The 15-foot-high Lebo Dam 2 (northeast dam, MT-653), impounding approximately 4735 acre-feet, is also classified as being of intermediate size. The downstream hazard potential classification of Dam 2 is also high (Category 1), because the drainageways for Dams 1 and 2 merge shortly below the dams. The 27-foot-high Lebo Dam 3 (east or main dam, MT-73), impounding approximately 4735 acre-feet, is also classified as being of intermediate size. The downstream hazard potential classification of Dam 3 is significant (Category 2), because of the road carried on the dam crest and the presence of 1 inhabitable structure downstream from the dam. Considering the fact that Dam 2 would overtop and fail first and the number of inhabitable structures within the potential flood path, we recommend that high-hazard criteria be applied to the entire project.

Inspection criteria (Ref. 1) recommend that an intermediate-sized project with a high downstream hazard potential be capable of safely handling a flood equal to the probable maximum flood (PMF). The PMF is the flood expected from the most severe combination of meteorologic and hydrologic conditions that are reasonably possible in the region. In Montana, east

of the continental divide, the critical flood for reservoirs with drainage areas the size of those for this project may result either from a generalized spring storm or from a severe thunderstorm during the late spring or summer. An estimated PMF was developed for the drainage basin during the dam safety analysis. This PMF, resulting from a 72-hour storm, has an estimated volume of 3040 acre-feet for Lebo Lake. The reservoir level at the beginning of the 72-hour storm was assumed to be at the principal spillway crest elevation, 4918.5 feet. Approximately 1630 acre-feet of storage is available between the principal spillway crest and the minimum embankment crest elevation of Dam 2, which has the lowest minimum crest elevation of the 3 dams.

Reservoir routings of the estimated PMF indicate that Lebo Lake will handle approximately 65% of the total PMF volume, or a flood having 67% of the PMF ordinates, before overtopping, if the low-level outlets are fully closed. The project will handle about 76% of the total PMF volume, or a flood having 80% of the PMF ordinates, before overtopping, if the low-level outlets are fully open. Dam 2 will erode and fail when overtopped by floodwaters.

On the basis of the field inspection and the study of hydrologic and operational data, the Lebo Lake project does not conform to Corps guidelines with respect to discharge and/or storage capacities to safely handle the PMF. This inability to handle PMF could lead to loss of life and property destruction.

Evidence or possible evidence of foundation or embankment seepage was found at or below the downstream toes of Dams 1 and 2. The lower portion of the downstream face of Dam 3 was obscured by a snowbank at the time of the inspection. Apparent surface dislocations were found on the downstream faces of all three dams. The seepage and surface dislocations, coupled with the probable low strength of the sandy to clayey silt embankment materials, indicate that the safety factor against shear failure under steady state seepage conditions for each of the dams may not conform to the inspection guidelines.

PRINCIPAL RECOMMENDATIONS

Due to storage between the normal pool and dam crest, the present project provides some degree of flood protection to the downstream area. The intent of report recommendations is to maintain or improve project safety, if feasible, without decreasing this existing flood protection.

Develop and immediately place in operation a downstream warning plan for use in the event of possible dam overtopping.

Conduct more detailed hydrologic and hydraulic routing studies to better determine the downstream hazard and required spillway capacity and modify the project as studies indicate.

Conduct field evaluations, laboratory tests, and engineering studies of embankment stability. Design modifications, as required, to provide for a safety factor of at least 1.5 under steady state seepage conditions for all 3 dams. In the analysis of the dams, consider the possibility of earthquake-induced shear failure or liquefaction of the embankment materials.

Inspect the low-level outlet conduits through the embankments and repair as required. Establish a program of periodic, comprehensive inspections to assure the continued safety of the project.

Stephen H. Nickel
Professional Engineer

PERTINENT DATA

1. GENERAL

Federal ID No.	MT-72 (Dam 1), MT-653 (Dam 2), MT-73 (Dam 3)
Owner	American Fork Ranch Stanton Brannin Tom Stevens Glennie Ranches George Glennie
Operator	Same
Purpose	Irrigation, recreation and stock watering
Location	Wheatland County, Montana
Watershed	Tributary to Musselshell River
Downstream Hazard Potential	MT-72 - High, MT-653 - High, MT-73 - Significant
USGS Quadrangle	Lebo Lake, Montana

2. RESERVOIR

Surface Area at Normal Pool	413 acres
Normal Storage (Principal Spillway Crest MT-73)	3105 acre-feet
Total Storage (Dam Crest MT-653)	4735 acre-feet
Surcharge Storage	1630 acre-feet
Drainage Area	2.7 square miles
Reservoir Elevation (8 May 1979)	4919.5 feet NGVD

3. EMERGENCY SPILLWAY - MT-72 (Dam 1)

Type	Uncontrolled earth channel
Crest Elevation	4920.0 feet NGVD
Width (Crest)	35 feet (approx.)
Spillway Capacity (Dam Crest MT-653)	170 cfs

4. PRINCIPAL SPILLWAY - MT-73 Dam 3)

Type	Corrugated metal pipe with concrete inlet riser
Controls	Slide gate in riser, with manual control from riser top and with water permitted to flow over the top of the closed slide gate and with additional uncontrolled side ports
Size	36 inches diameter
Length	140 feet

Riser Crest Elevation (Top of closed slide gate)	4918.5 feet NGVD
Riser Ports Crest Elevation	4919.0 feet NGVD
Outlet Invert	4897.4 feet NGVD
Normal Tailwater	4898.5 feet NGVD
Discharge Capacity (Dam Crest MT-653)	110 cfs

5. OUTLET WORKS MT-653 (Dam 2)

Type	Controlled corrugated metal pipe with concrete headwalls
Controls	Slide gate with manual control from dam crest
Size	24 inches diameter
Length	65 feet
Inlet Invert	4909.3 feet NGVD
Outlet Invert	4908.1 feet NGVD
Normal Tailwater	4910.0 feet NGVD
Discharge Capacity (Dam Crest MT-653)	40 cfs

6. DAMS

	Dam 1 MT-72	Dam 2 MT-653	Dam 3 MT-73
Type	Earth	Earth	Earth
Maximum Height	8 feet	15 feet	27 feet
Crest Length	500 feet	800 feet	388 feet
Crest Elevation (Min.)	4923.5 ft NGVD	4922.2 ft NGVD	4923.7 ft NGVD
Crest Width	11 feet	14 feet	25 feet
Upstream Slope	1(V) on 3.3(H)	1(V) on 3.3(H)	1(V) on 4.0(H)
Downstream Slope	1(V) on 2.2(H)	1(V) on 2.0(H)	1(V) on 2.8(H)* 1(V) on 2.0(H)**

* Above Berm
** Below Berm

CHAPTER 1

BACKGROUND

1.1 INTRODUCTION

1.1.1 Authority and Scope

This report summarizes the Phase I inspection and evaluation of Lebo Lake Dams 1, 2, and 3, owned by the American Fork Ranch and Glennie Ranches of Wheatland County, Montana.

The National Dam Inspection Act, Public Law 92-367 dated 8 August 1972, authorized the Secretary of the Army, through the Corps of Engineers to conduct safety inspections of non-federal dams throughout the United States. Pursuant to that authority, the Office of the Chief of Engineers issued "Recommended Guidelines for Safety Inspection of Dams" (Ref. 1) in May 1975.

The recommended guidelines were prepared with the help of engineers and scientists highly experienced in dam safety from many federal and state agencies, professional engineering organizations and private engineering consulting firms. Consequently, the evaluation criteria presented in the guidelines represent the comprehensive consensus of the engineering community.

Where necessary the guidelines recommend a two-phased study procedure for investigating and evaluating existing dam conditions so deficiencies and hazardous conditions can be readily identified and corrected. The Phase I study is:

(1) a limited investigation to assess the general safety condition of the dam;
(2) based upon an evluation of the available data and a visual inspection;
(3) performed to determine if any needed emergency measures and/or if additional studies, investigations and analyses are necessary or warranted;
(4) not intended to include extensive explorations, analysis or to provide detailed alternative correction recommendations.

The Phase II investigation includes all additional studies necessary to evaluate the safety of the dam. Included in Phase II, as required, should be additional visual inspections, measurements, foundation exploration and testing, material testing, hydraulic and hydrologic analyses and structural stability analyses.

The authority for the Corps of Engineers to participate in the inspection of non-federally owned dams is limited to Phase I investigations with the exception of situations of extreme emergency. In these cases the Corps may proceed with Phase II studies but only to the extent needed to answer

serious questions relating to dam safety that cannot be answered otherwise. The two phases of investigations outlined above are intended only to evaluate project safety and do not encompass in scope the engineering required to perform design or corrective modification work. Recommendations contained in this report may be for either Phase II safety analyses or detailed design study for corrective work.

The responsibility for implementation of the Phase I recommendations rests with the dam owner and the State of Montana. It should be noted that nothing contained in the National Dam Inspection Act, and neither action nor failure to act under this Act shall be construed (1) to create liability in the United States or its officers or employees for the recovery of damage caused by such action or failure to act or (2) to relieve an owner or operator of a dam of the legal duties, obligations, or liabilities incident to the ownership or operation of the dam.

1.1.2 Purpose

The purpose of the inspection and evaluation is to identify conditions that threaten public safety, so that they may be corrected in a timely manner by non-federal interests.

1.1.3 Inspection

The findings and recommendations in this report were based on visual inspection of the project on 8 May 1979 and an interview with the owners. Drawings of modifications made in 1969 were furnished and are reproduced as Plates 2 and 3. No other design drawings or foundation exploration results were available for review or analysis. Inspection procedures and criteria were those established by the "Recommended Guidelines for Safety Inspection of Dams" (Ref. 1).

Personnel present during the inspection included:

Louis Boitano, Civil Eingineer, Seattle District Corps of Engineers

Lawrence Tegg, State of Montana, Department of Natural Resources and Conservation

Jane L. Glennie, Secretary-Treasurer and General Manager, Glennie Ranches, owner of half-interest in Lebo Lake

Stanton Brannin, Vice-president and General Manager, American Fork Ranch, owner of half-interest in Lebo Lake

Hoskins-Western- Sonderegger, Inc., personnel who participated in the field inspection and contributed to this report are:

Stephen Nickel, Geotechnical Engineer, Team Leader

Richard Walker, Hydrologist/Hydraulics Engineer

1.2 DESCRIPTION OF PROJECT

1.2.1 General

Lebo Lake is an off-channel irrigation storage impoundment for waters diverted from several creeks lying to the south and west of the reservoir. The lake is located in Wheatland County, Montana. The lake lies in a natural depression which has 3 drainageways leading out of it. A dam has been built on each of the drainageways to allow for the storage of more water than could be stored naturally and to permit controlled releases for irrigation. A township corner lies in the lake, which results in the dams being in various sections. Dam 1 (northwest dam) and the left abutment of Dam 2 (northeast dam) are in Sec. 36, T7N, R13E. All of Dam 2 except the left abutment is in Sec. 31, T7N, R14E. Dam 3 (east or main dam) is in Sec. 6, T6N, R14E. Most of the lake is in Sec. 1, T6N, R13E.

Lebo Dams 1, 2, and 3 are 8, 15, and 27 feet high, respectively, and together impound approximately 3105 acre-feet at the normal pool elevation of 4918.5 feet (principal spillway crest). However, according to the owner, only about 10 feet of water is available for irrigation. The total natural drainage area is approximately 1728 acres. The lake has a normal surface area of approximately 413 acres. Based on a visual reconnaissance and engineering judgment approximately 6 houses, the town of Two Dot, the C, M, St. P & P Railroad, and U.S. Highway 12 could be affected by a sudden breach of either Dam 1 or 2, and one inhabitable structure and U.S. Highway 191 could be affected by a sudden breach of Dam 3. On the basis of this information and in accordance with the Recommended Guidelines (Ref. 1), the dams are classified as intermediate in size, and the downstream hazard potential classification of Dams 1 and 2 is high (Category 1). Dam 3 has a significant (Category 2) downstream hazard potential classification.

The principal diversion canal enters at the southwest extremity of the reservoir. Dam 2 has a low-level gated outlet with a 24-inch-diameter corrugated metal pipe conduit which is used for irrigation releases to Big Elk Creek. Dam 3 has a reinforced concrete riser containing an upstream vertical slide gate with a spill-over top and ungated ports, all of which lead to a 36-inch-diameter corrugated metal pipe conduit. The spill-over top of the slide gate maintains the normal pool elevation, while the slide gate controls irrigation releases to the Lebo-American Fork Creek system. This outlet at Dam 3 is considered the principal spillway for the reservoir. The emergency channel spillway is 35 feet wide at the control section and is excavated into the right abutment of Dam 1.

1.2.2 Regional Geology

The drainage area of the Musselshell River is a region of basin and range complicated by thrust faulting. Geographically, the Big Snowy Mountains and the Little Belt Mountains are on the north, the Crazy Mountains are on the south, the Castle Mountains are in the middle, and the Big Belt Mountains are on the west, forming a semicircle of mountains around a group of basins extending generally eastward onto the Great Plains.

Before the late Cretaceous, this was an area of quiet basinal sedimentation. Pre-Cambrian, Paleozoic, and Mesozoic sedimentation produced sandstones and shales. These Pre-Cambrian and Lower and Middle Paleozoic sedimentary and metamorphic rocks are exposed in the mountains and are only exposed due to the mountain-building that occurred here.

During this mountain-building phase, the basinal sediments were formed into a dome containing smaller anticlines and synclines. The most prominent of these are the Little Belt Mountains and the Snowy Mountains. Subsequent to the mountain building came erosion. Erosional debris from the mountains swept down by rivers and streams covered the earlier Cretaceous sandstones and shales and formed the Eocene Fort Union formation, consisting of sandstone, shale, and bituminous coal.

Subsequent erosion of this domed basis has produced the present topography which shows a rim of Fort Union deposits with succeedingly older Cretaceous deposits toward the center of the present smaller basins. These Cretaceous deposits are predominantly the sandstones and shales of the Livingstone Formation. The oldest formation exposed in the basins is the Colorado Shale. Later Tertiary gravels and sands form the terraces and benches of the Musselshell River with Pleistocene alluvium along the recent bed of the river.

1.2.3 Seismicity

Lebo Lake lies very close to the boundary between Seismic Zone 2 and Seismic Zone 3 as indicated by the Seismic Zone Map (Ref. 1). The seismic probability of Zone 2 is one of a potential for moderate damage, while that of Zone 3 is one of a potential for major damage. The seismic probability is based on the known distribution of damaging earthquakes in the region. Because seismic zone boundaries are approximate, seismic design parameters for Seismic Zone 3 should be applied (Ref. 1).

No major faults have been mapped in the immediate vicinity of the lake, although traces of minor faults can be inferred from aerial photographs and topographic maps. No active faults were found or inferred at the sites of the dams. The closest faults identified on the Geologic Map of Montana lie 15 miles north and 15 miles west of the lake.

Epicenters of local earthquakes significant enough to be reported in References 13 and 14 occur approximately along a line from 20 miles northwest of Helena to 25 miles north of Bozeman. The 3 largest reported earthquakes along this line have had intensities of VIII (Modified Mercalli). One of these earthquakes had its epicenter at a point 25 miles north of Bozeman, (27 June 1925), while the other two occurred at Helena (18 October and 31 October 1935). Of these 2 epicentral areas, the former is 65 miles and the latter 105 miles from the reservoir. No reported earthquakes have occurred at distances of less than 65 miles from the reservoir.

1.2.4 Site Geology

Lebo Lake lies in a southeasterly-plunging anticline which has been eroded

to form a topographic basin. At the lake site the erosion has exposed shale of the Colorado group. The hills circling the site to the east and south (see Photo 1) are the outcrop of the Eagle sandstone. In the valley of Big Elk Creek, north and west of the lake, the Colorado shale has been covered with Quaternary alluvium. Recent alluvium, probably less than 10 feet thick, fills the bottoms of the drainageways where the dams are standing.

1.2.5 Design and Construction History

At the time of the inspection, the owners stated that the lake was dammed many years ago by an irrigation company, and, that through a number of acquisitions and other transactions, their respective ranches each came to own half-interests in the dams and the lake. They said that the lake contains a large quantity of silt and that only about 10 feet of water is available. The height of the dams was said to have been raised an unknown amount in the late 1940's and to have been raised an additional 4 feet in 1969.

Plans for the work in 1969 were prepared by the Soil Conservation Service. The plans for this work were made available and are included as Plates 2 and 3 of this report. No other plans or construction records are available. The numbering system for the dams (1, 2, and 3) is a continuation of the system used by the Soil Conservation Service for the 1969 work.

Dam 1-(northeast) was not constructed in accordance with the plans. The plans show the upstream and downstream slopes to be 1 vertical (V):4 horizontal (H) and 1(V):2(H), respectively. During the inspection the slopes were measured as 1(V):3.3(H) and 1(V):2.2(H), respectively. In addition, the project's emergency spillway, located in the right abutment of Dam 1, is not as shown on the plans. The approach channel, as constructed, is straight (see Photo 4), and the spillway width is 35 feet, rather than 50 feet.

CHAPTER 2

INSPECTION AND RECORDS EVALUATION

2.1 HYDRAULICS AND STRUCTURES

2.1.1 Spillways

The principal spillway for Lebo Lake is the ported, reinforced concrete riser intake tower located at the upstream end of the 36-inch-diameter corrugated metal pipe conduit through Dam 3. The tower has a slide gate located on its upstream face. The gate is a steel plate with a rising-stem control operated from the top of the riser. The steel plate forms the upstream side of the riser. With the gate in the closed position, flow passes over the top of the gate. Flow passes beneath the gate when it is raised. The slide gate and pipe, thus, also serve as the low-level outlet for Dam 3. The horizontal dimension of the slide gate is approximately 3.5 feet, and the vertical height is approximately 8 feet. With the gate fully lowered, the top of the gate is at elevation 4918.5 feet, which is 3.7 feet below the minimum dam crest elevation of Dam 2. In addition to the slide gate, the principal spillway structure has uncontrolled intake ports, with trash racks, located on both sides of the intake tower. These ports each have a vertical dimension of 1 foot and a horizontal dimension of 3.5 feet. The invert elevation (4919.0 feet) of the two ports is 3.1 feet below the minimum dam crest elevation and 0.5 feet above the top of the slide gate. The principal spillway structure can best be seen in Photo 13.

The discharge capacity of the 36-inch CMP ranges from 0 cfs at the normal pool elevation of 4918.5 feet (slide gate fully lowered) to approximately 110 cfs at the minimum dam crest elevation of 4922.2 feet, with the slide gate in either the fully raised or lowered position. With the slide gate fully open, full pipe (pressure) flow exists over a range of reservoir elevations. The rating curve for the principal spillway is shown on Plate 7.

A complete inspection of the conduit during the inspection was impossible due to the amount of flow (approximately 20-30 cfs) in the pipe. However, the portion of the conduit that was visible was in good condition.

The 36-inch CMP outlet has no stilling basin or energy dissipator. Some erosion is occurring at the top and sides of the outlet headwall and in the outlet channel (see Photo 15). The 40-foot-wide berm on the downstream slope of Dam 3 prevents this erosion from posing any threat to the integrity of the embankment. Photo 16 shows the outlet channel downstream from the dam. This channel carries the uncontrolled overflow or controlled releases back to Lebo Creek and American Fork Creek.

The emergency spillway channel for the project does not have the same general configuration as shown on the construction plans (Plate 3), since

the approach channel is straight. In addition, the cross section of the channel taken during the inspection revealed the channel has an average bottom width of 35 feet, not 50 feet as shown on the plans. The side slopes of the channel are both approximately 1(V):3(H) which is consistent with the plans. The profile of the spillway is approximately level from the control section back into the reservoir as Plate 3 indicates. Approximate dimensions and relative elevations were determined in the field for use in calculating the discharge capacity rating of the spillway channel.

The control section for the emergency spillway channel (crest elevation 4920.0 feet) is located at the downstream end of the channel because of the break in slope and convergence of the spillway cross section (Photo 4). The approach channel to the control section is heavily grazed and free of any brush or dense growth. The discharge rating for the emergency spillway was computed by assuming that critical depth occurred at the control section and computing water surface profiles upstream into the reservoir using the HEC-2 program. A Manning's "n" value of 0.035 was used for the bottom and sides of the channel because of the short vegetation and relatively flat surfaces. There is no energy dissipator in the channel. However, once the water leaves the channel, it enters a broad, relatively flat drainageway where the velocity and depth would be significantly reduced. Because of the nature of the downstream channel and the separation from the embankment, it is unlikely that high flows in the spillway would in any way affect the integrity of the dam. The discharge of the emergency spillway at the minimum dam crest elevation of 4922.2 feet was computed to be 170 cfs. The emergency spillway rating curve is shown on Plate 6.

2.1.2 Outlet Works

Dam 2 (MT-653)

The low-level gravity outlet through Dam 2 is a 24-inch-diameter corrugated metal pipe with a slide gate on the upstream headwall. A cross section of this outlet is shown on Plate 2. The outlet pipe inlet invert is approximately 13 feet below the minimum crest elevation of the dam and 11 feet below the emergency spillway crest elevation. The outlet discharge rating curve was computed assuming the slide gate to be fully open and the downstream outlet to be almost submerged. The rating curve is shown on Plate 8. The discharge capacity of the 24-inch CMP outlet is 40 cfs with the reservoir at the minimum crest elevation of the dam. The slide gate controls and headwall are shown in Photos 10 and 11, and channel conditions downstream are shown in Photo 9. A visual inspection of the pipe was impossible due to the submerged condition at the downstream end of the outlet. There is no stilling basin or energy dissipator for the outlet conduit. No erosion at the outlet was observed.

Dam 3 (MT-73)

As previously stated, the slide gate and 36-inch-diameter CMP, which comprise part of the principal spillway for the project, also function as the low-level

gravity outlet through Dam 3. With the gate in a raised position, flow passes under the gate and through the 36-inch CMP. The maximum possible vertical opening is estimated to be 2 feet. The minimum invert elevation, 4910.5 feet, is 11.7 feet below the minimum dam crest elevation and 8.0 feet below the top of the slide gate. Due to the submerged condition at the time of inspection, a visual inspection of the low-level outlet was impossible. The discharge rating curve for the facility is included in that for the principal spillway and is shown on Plate 7.

The rising stem control mechanism for the slide gate is located on top of the intake riser and has a pulley and hook attached. The pulley and hook appear to be designed as an aid for lowering a person into the riser. The control mechanism, pulley and hook can best be seen on Photo 13.

2.1.3 Diversion Canals

The major sources of inflow to Lebo Reservoir are an extensive diversion canal system which is fed by waters from American Fork Creek and its tributaries, as well as the Crooked Creek-Big Elk Creek system (Ref. 15). The major diversion canal can be seen entering the Lake from the west on Plate 1 and Photo 1. The maximum hydraulic inflow capacity of this canal system is estimated to be 50 to 110 cfs based on historic water rights allocations to the canals named.

2.1.4 Freeboard

Freeboard on the three dams varies. The elevation at the top of the slide gate in the principal spillway intake riser, 4918.5 feet, was assumed to be the normal pool elevation. This results in the following wave run-up and set-up for the individual dams.

Dam 1 (MT-72)

The fetch for wind generated waves is 6500 feet, and the resulting wave run-up and set-up on the embankment is approximately 3.5 feet. An approximate 5-foot difference exists between the minimum dam crest elevation of 4923.5 feet and the normal pool elevation of 4918.5 feet. This freeboard is considered adequate in preventing waves overtopping when the pool is at the normal operating level.

During the PMF, assuming the dam with the lowest crest elevation overtops and fails, the maximum water surface elevation was calculated to be 4923.0 feet. The 0.5-foot difference between the pool elevation and the minimum dam crest elevation would be inadequate in preventing wave overtopping.

Dam 2 (MT-653)

The fetch for wind-generated waves is 6500 feet, and the wave run-up and set-up on the embankment is approximately 3.5 feet. An approximate 3.7-foot difference exists between the minimum dam crest elevation of 4922.2

feet and the normal pool operational level of 4918.5 feet. Therefore, the operational freeboard is marginal in preventing wave overtopping.

During the PMF, the maximum water surface elevation of 4923.0 feet would exceed the minimum crest elevation of 4922.2 feet, and no freeboard would exist.

Dam 3 (MT-73)

The fetch for wind-generated waves is 4000 feet, and the wave run-up and set-up on the embankment is approximately 3.0 feet. An approximate 5.2-foot difference exists between the minimum crest elevation of 4923.7 feet and the normal pool elevation of 4918.5 feet. This freeboard is considered adequate in preventing wave overtopping.

During the PMF, the maximum water surface was calculated to be 4923.0 feet. The resulting 0.7-foot difference between the pool elevation and the minimum dam crest elevation would be inadequate in preventing wave overtopping.

2.2 HYDROLOGY, CLIMATOLOGY, AND PHYSIOGRAPHY

2.2.1 Physiography and Climatology

The climate of the area around Lebo Lake is highly variable, having great temperature extremes, and is most generally characterized as continental. The effects of foehn or chinook winds, which are westerly or southwesterly and Pacific Maritime in origin, are important in determining the extreme precipitation and runoff conditions which occur in this area. The summers are warm with cool nights and low humidity while winters are moderately cold and highly variable in severity.

Harlowton, in Wheatland County, is the nearest climatological station and is located 13 miles to the northeast in the Musselshell River Valley at elevation 4200 feet. Precipitation and climatological data are available for approximately 90 and 70 years, respectively. The mean annual precipitation at Harlowton is about 14 inches. The mean annual precipitation at Lebo Lake is estimated to be approximately 14 inches (Ref. 4). Temperature extremes at Harlowton range from approximately -50^{o} to 100^{o} F. The average expected date of the last freeze is June 4th, and the average first freeze date is September 7th.

The drainage basin which extends south and west of the reservoir is trapezoidal in shape and encompasses an area of approximately 2.7 square miles. The basin elevations range from the normal pool elevation of 4918.5 feet to approximately 5276 feet at the extreme southwest corner of the basin. The ground slopes vary from approximately 60 feet in one mile to the west to a maximum of about 2500 feet in one mile to the south. The Crazy Mountains and Castle Mountains lies south and west of the reservoir, respectively.

2.2.2 Reservoir Storage and Spillway Discharge

The reservoir has a surface area of about 413 acres and a storage of about 3105 acre-feet at the principal spillway crest elevation of 4718.5 feet. Storage of approximately 1730 acre-feet is available between this principal spillway crest and the minimum crest elevation of the dam, 4722.2 feet. The total discharge for the principal and emergency spillways at the minimum dam crest is approximately 280 cfs. The discharge capacity of the facility would increase an additional 40 cfs if the low-level outlet were completely open and free of obstructions.

2.2.3 Estimated Probable Maximum Flood

The Probable Maximum Flood (PMF) is defined as the flood expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. In Montana, east of the Continental Divide, the critical flood for a given reservoir may result either from a generalized spring storm or from a severe local thunderstorm during late spring or summer. A storm, the intensity of which approached probable maximum precipitation (PMP) intensity, did occur in Montana in June 1964.

Historic flood flows for the general area have been documented and recorded. American Fork Creek below the Lebo Creek confluence, located 16 miles east northeast of Lebo Lake, has had a flood of record of 9.5 cfs per square mile on 166 square miles. Antelope Creek, another tributary of the Mussel-shell River, located 17 miles northeast of Lebo Lake, has had a flood of record of 275 cfs per square mile on 88.7 square miles. The USGS classifies these basins as having similar flood flow characteristics to the Lebo Lake basin (Ref. 4).

A PMP storm of 72-hour duration was applied to the basin. The 24-hour, 6-hour and 1-hour PMP depths were estimated from the National Weather Service Technical Paper 38 (Ref. 8) to be 17.50 inches, 14.00 inches and 8.57 inches, respectively. The 48- and 72-hour PMP depths were taken as 110 percent and 115 percent of the 24-hour PMP values, respectively. All 6-hour increments from 0 to 24 hours and the hourly increments of the maximum 6-hour increment were arranged in a critical order of occurrence.

The PMF was assumed to result from a PMP storm in the late spring, over hard and frozen ground. Therefore, a constant soil loss rate of zero was applied throughout the 72-hour PMP storm in accordance with Corps of Engineers recommendations. Thus, the overall configuration of the 72-hour storm is not affected by losses in the soil, and the basin rainfall is equal to the basin runoff for all storm increments. Direct precipitation onto the surface of the lake was also added in with no losses.

2.2.4 Flood Routing

A flood routing of the PMF was made to define the total volume of the PMF and the volume of the PMF that could be handled by the reservoir storage and spillway capacity before overtopping. For routing the PMF through

Lebo Lake, the lake level at the beginning of the PMP storm was assumed to be at the principal spillway crest elevation of 4918.5 feet, which would correspond to the normal pool condition. The total volume of the 72-hour PMF for Lebo Lake is 3040 acre-feet with a peak flow rate of 18,640 cfs. Two routings were made. The first routing indicated that with the control gates of both low-level outlets closed, the lake will handle, through storage and spillway discharge, approximately 65% of the PMF volume before the dams are overtopped. The second routing showed that with both of the control gates completely open, the project would handle approximately 76% of the PMF volume before the dams would overtop.

Routings were also made of lesser hypothetical floods than the PMF to determine the magnitude of floods the dams can contain. The hypothetical hydrographs are obtained by applying percentages to the PMF ordinates. Floods having hydrograph ordinates corresponding to 67% (low-level outlet gates closed) and 80% (low-level outlet gates open) of the PMF ordinates are just controlled by the project.

The PMF inflow hydrographs were developed using the SCS dimensionless unit hydrograph. These hydrographs were generated and combined using the HEC-1 (Dam Safety Version) computer program (Ref. 9). The reservoir routing of the PMF was made using the Modified Puls method contained in the HEC-1 program.

2.3 GEOTECHNICAL EVALUATION

2.3.1 Embankments

Dam 1

The 8-foot-high Dam 1 (northwest) has a crest length of 500 feet and a crest width of 11 feet. The upstream slope is 1 vertical (V):3.3 horizontal (H), while the downstream slope is 1(V):2.2(H). The material for the dam appears to have been obtained primarily from the excavation for the emergency spillway, in the right abutment. The soil exposed on the crest and downstream face of the embankment around rodent holes and on the surface in the emergency spillway is a sandy to clayey silt, with small amounts of gravel. This material should be considered very erodible.

Riprap covers the central portion of the upstream face, but it does not extend to the abutments (see Photo 2). The riprap appears to be sandstone, ranging up to about 18 inches in diameter. Very little degradation has occurred. There is no granular filter or bedding material under the riprap.

The embankment surfaces not covered with riprap are adequately vegetated with grasses and sage. Some minor frost dislocation of sod on the downstream face has occurred.

Rodent holes were found on all embankment surfaces, including the area covered by riprap.

Dam 2

The 15-foot-high Dam 2 (northeast) has a crest length of 800 feet and a crest width of 14 feet. The upstream slope is 1(V):3.3(H), and the downstream slope is 1(V):2.0(H). The material exposed on the surface of Dam 2 around rodent holes is a sandy to clayey silt with some gravel. The borrow source is not known. This material should be considered very erodible.

Except for a concrete headwall at the location of the low-level outlet, the upstream face is covered with coarse riprap, generally ranging from 6 inches to 30 inches in diameter and containing no fines or spalls. There is no granular filter or bedding material under the riprap, and wave action is eroding embankment material through the riprap in several locations. The concrete headwall for the outlet slide gate is deteriorating, with many cracks and spalls (see Photos 10 and 11).

Vegetation on the crest is grass, with about 50% coverage. The crest is used as a road and has deep ruts which pond water. The downstream face is covered with grass and wild roses. There is considerable frost dislocation of sod on the downstream face, resulting in an uneven slope (see Photo 8).

Many rodent holes exist on the crest and the downstream face.

Dam 3

The 27-foot-high Dam 3 (east or main dam) has a crest length of about 390 feet and a crest width of 25 feet. A gravel-surfaced county road is carried on the crest. The upstream slope is 1(V):4(H). The configuration of the downstream face is a slope of 1(V):2.8(H) for the upper approximately 8 feet, a berm 40 feet wide with a slope of 1(V):13(H), and a slope of 1(V):2.0(H) below the berm. The material exposed on the downstream face is a sandy to clayey silt with very little gravel. The borrow source is not known. This material should be considered very erodible.

Except for the concrete headwall in the vicinity of the principal spillway riser, the upstream face is covered by riprap ranging from about 3 inches to about 15 inches in diameter, with some larger pieces. The upper slope on the downstream face is covered with similar riprap (see Photos 13 and 14). No granular filter or bedding material was seen under the riprap. The exposed portion of the concrete headwall appeared in good condition. There is some cracking on the top of the wall near fence posts which have been set into the wall.

Grass covers the portions of the embankment not protected by gravel surfacing or by riprap. No frost dislocation of sod was found.

A few rodent holes were found on the downstream face.

2.3.2 Foundation Conditions, Seepage, and Drainage

From the geologic assessment performed in conjunction with this inspection, the foundations of all three dams appear to be composed of deposits of alluvial silts and sands, generally less than 20 feet thick, lying in channels eroded into shales of the Colorado group, although bedrocks at Dam 3 may be the Eagle sandstone.

At the time of inspection the reservoir water surface elevation was 4919.5 feet, which is 4.0 feet, 2.7 feet, and 4.2 feet below the minimum crest elevations of Dam 1, Dam 2, and Dam 3, respectively.

Dams 1 and 2 showed no evidence of seepage through the embankments. Dam 1 showed vegetative evidence of some foundation seepage, while Dam 2 exhibited evidence of considerable foundation seepage in the form of free water standing above the outlet channel elevation for at least 100 feet downstream from the embankment (see Photo 9). For these dams, the alluvial foundation materials appear to be more permeable than the embankments.

No seepage was occurring through the upper portion of the Dam 3 embankment or on the berm. However, water in the exit channel and a snowbank prevented a determination of whether seepage was occurring either above the toe or through the foundation at the maximum section (see Photo 15).

The embankments contain no internal zoning or drainage systems. Also, there is no instrumentation, such as piezometers, installed in any of the dams.

2.3.3 Stability

There are no stability analyses on file for any of the dams. The guidelines recommend that stability and seepage analyses be on file for all high hazard dams. In addition, the minimum acceptable safety factor is 1.50 for downstream slopes under steady seepage conditions.

Surface creep with noticeable dislocations was found over most of the downstream face of Dam 2, especially left of the conduit, and below the berm on the downstream face of Dam 3. Surface creep with small movements was found at scattered locations on the downstream face of Dam 1. No evidence of instability was found on or above the berm on the downstream face of Dam 3. The exact causes of the creep failures are unknown; however, they may have been caused by low-strength embankment material coupled with surface saturation or by frost action in the embankment soil.

The presence of creep, to some extent, on all three dams could indicate marginal stability.

2.4 PROJECT OPERATION AND MAINTENANCE

2.4.1 Dams

There is no formal plan for performing periodic maintenance on the Lebo Lake dams. Maintenance appears to be performed on a piecemeal basis. Rodent burrows constitute the major lack of regular maintenance. There are numerous rodent burrows on all surfaces of the three dams.

The second area of lack of proper maintenance is in the condition of the crest of Dam 2 and the berm of Dam 3. Vehicle traffic in wet weather has caused deep wheel ruts in these areas. The crest and berm need to be regraded to remove the ruts since the water that is caught in the ruts can lead to further softening of the embankments.

The third area where maintenance may be required is the riprap. On all three dams the riprap appears to be improperly graded, since there is some removal of embankment material through the riprap by wave action. The problem is made more serious by the apparent lack of a granular filter blanket between the riprap and the embankments.

The last area where regular maintenance appeared to be lacking was on the concrete headwall of Dam 2 (see Photos 10 and 11). The west end of the wall is weathered and spalled, and the buttresses are also weathered and spalled at approximately the normal pool elevation.

2.4.2 Reservoir

The level of Lebo Lake fluctuates seasonally, being low in winter, full by the start of the irrigation season, and low again by autumn. Water is obtained through a diversion canal from Lebo Creek by way of the unnamed tributary of Crooked Creek which leads to Lebo Lake. Dams 2 and 3 have outlets controlled by slide gates for the release of irrigation water. There is some erosion on the shores of the reservoir. However, no remedial action is needed.

2.4.3 Warning System

There is no formal warning system or plan of action to warn downstream inhabitants in the event of impending dam failure.

CHAPTER 3

FINDINGS AND RECOMMENDATIONS

3.1 FINDINGS

Visual inspection of Lebo Lake and Dams, supplemented by analysis of the project in terms of the recommended guidelines' performance standards, resulted in the following findings.

3.1.1 Size and Hazard Classification and Safety Evaluation

According to the "Recommended Guidelines for Safety Inspection of Dams" (Ref. 1), Lebo Dam 1 (MT-72), Lebo Dam 2 (MT-653), and Lebo Dam 3 (MT-73) are all classified as being of intermediate size. Dam 1 and Dam 2 are classified as having a high downstream hazard potential. Dam 3 has a significant downstream hazard potential.

The recommended spillway design flood for this project is 100% of the PMF (Ref. 1). However, the project cannot safely handle the PMF without Dam 2 overtopping and failing. Because the project is incapable of controlling the full PMF without overtopping and failing, the Lebo Lake project does not meet inspection guidelines.

3.1.2 Embankment Dams

The downstream slopes of all three dams show signs of embankment surficial instability. Evidence of seepage water was found below the toe of Dam 1, and water was observed seeping from the toe of Dam 2. Melting snow prohibited examining the toe area of Dam 3 for seepage. The upstream faces of all dams appeared to be stable but are subject to loss of embankment material through the coarse-graded riprap. There are no piezometers, and stability analyses have not been conducted. Sufficient information is not presently available for evaluation of stability.

Rodent burrows were visible on all surfaces of the three dams, including riprapped areas. Rodent burrows are especially dangerous in dams like those at Lebo Lake, where the fine-grained embankment material is susceptible to erosion and piping.

The crest of Dam 2 was deeply rutted by vehicle use in wet weather. In addition, some brush has been allowed to grow on the upstream face of Dam 2 (see Photos 6 and 7).

3.1.3 Outlet Works

Lebo Lake has two low-level outlets with manually controlled slide gates. One outlet is a 24-inch CMP through Dam 2 (MT-653) and has a maximum discharge capacity of about 40 cfs. The other outlet is a 36-inch CMP through

Dam 3 (MT-73). This outlet is part of the principal spillway for Lebo Lake. The maximum discharge of the low-level outlet and principal spillway at Dam 3 is about 110 cfs.

With the principal spillway slide gate in the fully-open position, full pipe (pressure) flow will exist in the 36-inch CMP over a range of reservoir elevations. If the 36-inch CMP is not capable of withstanding pressure flow conditions, embankment material may be washed out along the conduit. This is a potentially dangerous situation, especially since there is presently no way of closing the principal spillway.

3.1.4 Spillway and Reservoir Capacity

The principal spillway, as previously mentioned, consists of the uncontrolled slide gate crest and the ports in the concrete riser in Dam 3. The maximum discharge capacity of this facility is 110 cfs.

The emergency spillway is an uncontrolled earth channel in the right abutment of Dam 1. The emergency spillway crest is 2.2 feet below the minimum crest elevation of Dam 2. The maximum capacity of the spillway is 170 cfs at the minimum dam crest elevation of the dams.

The lake storage and spillway discharge capacities are insufficient to prevent overtopping of the dam during the PMF.

3.1.5 Operation and Maintenance

Operation and maintenance are performed by the owners or their employees. Dam 3 is crossed by a county road and is probably observed frequently. Dam 2 is beside the same county road and can be observed readily. However, it is probably visited only when necessary. Dam 1 is not visible from the road, is not readily accessible by vehicle, and appears to be visited infrequently. Water is diverted to the lake from Lebo Creek and by way of a Crooked Creek tributary. It is then released as needed through the low-level outlets of Dam 2 or Dam 3. As a consequence, the lake level fluctuates seasonally.

Maintenance of the dams is not adequate, as evidenced by rodent burrows on all surfaces of all three dams, vehicle ruts on the crest of Dam 2, loss of embankment material through the riprap, and concrete deterioration in the headwall of the low-level outlet on Dam 2.

There is no formal warning system or plan of action to alert downstream inhabitants in the event that dam failure is immminent.

3.2 RECOMMENDATIONS

Due to the availability of storage between the normal pool elevation and the dam crest, the present project provides a degree of flood protection

to the downstream area. The intent of the recommendations in this report is to maintain or improve project safety, if feasible, without decreasing this existing flood protection.

1. Immediately develop, implement, and periodically test an emergency warning plan for use in the event of dam overtopping or failure by other means.

2. Eliminate rodent populations on the dams and repair rodent damage. Remove all brush from the embankments and take steps to prevent regrowth.

3. Repair the spalling concrete in the upstream headwall of the low-level outlet in Dam 2.

4. Regrade the crest of Dam 2 to remove deep wheel ruts. Place a gravel surface on the crest if the dam is to be used as a roadway in wet weather.

5. Establish and carry out a program of regular maintenance to continue the measures stated in Recommendations 2, 3, and 4.

6. Conduct engineering studies to ascertain the stability of the dams (including seismic stability), to evaluate the apparent surface instability on the downstream faces of the dams, and to investigate the problem of erosion of embankment material through the riprap. Modify dam(s) as studies indicate. The studies, to be performed by an experienced geotechnical engineer and to be maintained on file, should include, but not necessarily be limited to:

   - Sampling and testing of soils in the dams, the foundations, and the abutments;
   - Installation, maintenance, and evaluation of piezometers in the dams and abutments and along the downstream toes;
   - Evaluation of the gradation of the riprap with respect to its suitability for preventing the migration of the embankment material under wave action.

7. Conduct more detailed hydrologic and hydraulic routing studies to better determine the downstream hazard and required spillway capacity and modify the project as studies indicate.

8. Modify the principal spillway to prevent pressure flow in the 36-inch CMP or insure that the CMP will withstand pressure. Develop and implement a method for emergency closure of the principal spillway.

9. Inspect the low-level outlet conduits through the embankments and repair as required.

10. Conduct periodic comprehensive inspections at no more than five-year intervals. These inspections should be performed by qualified engineers with experience in embankment dam design and construction.

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14. U.S. Geological Survey, Earthquake Information Bulletin, Washington, D.C., 1973-1978.

(PHOTO 1) Overview, Lebo Lake and Dams.

(PHOTO 2) Upstream face of Dam 1 from left abutment.

(PHOTO 3) Downstream face of Dam 1 from right abutment. Emergency spillway in foreground.

(PHOTO 4) Looking upstream in emergency spillway.

(PHOTO 5) Looking downstream in emergency spillway.

(PHOTO 6) Upstream face of Dam 2.

(PHOTO 7) Downstream face of Dam 2 from right abutment.

(PHOTO 8) Downstream face of Dam 2. Surface dislocations in foreground. Outlet submerged, left of fence.

(PHOTO 9) Looking downstream from crest of Dam 2. Seepage water visible below toe.

(PHOTO 10) Dam 2, upstream headwall of low-level outlet. Note deteriorated concrete.

(PHOTO 11) Dam 2, low-level outlet operating works.

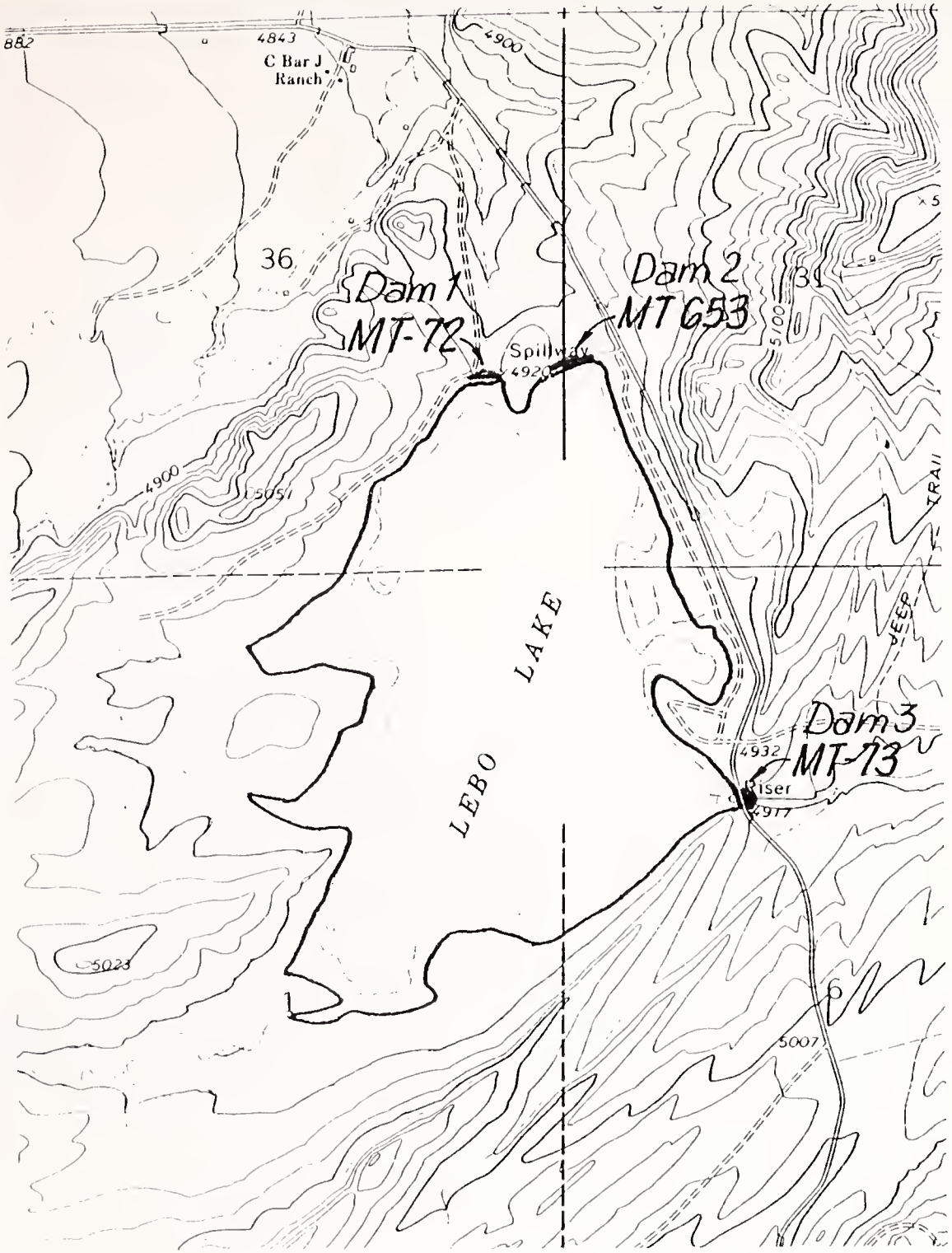
(PHOTO 12) Upstream face of Dam 3.

(PHOTO 13) Dam 3, upstream headwall, riser, and outlet operating works.

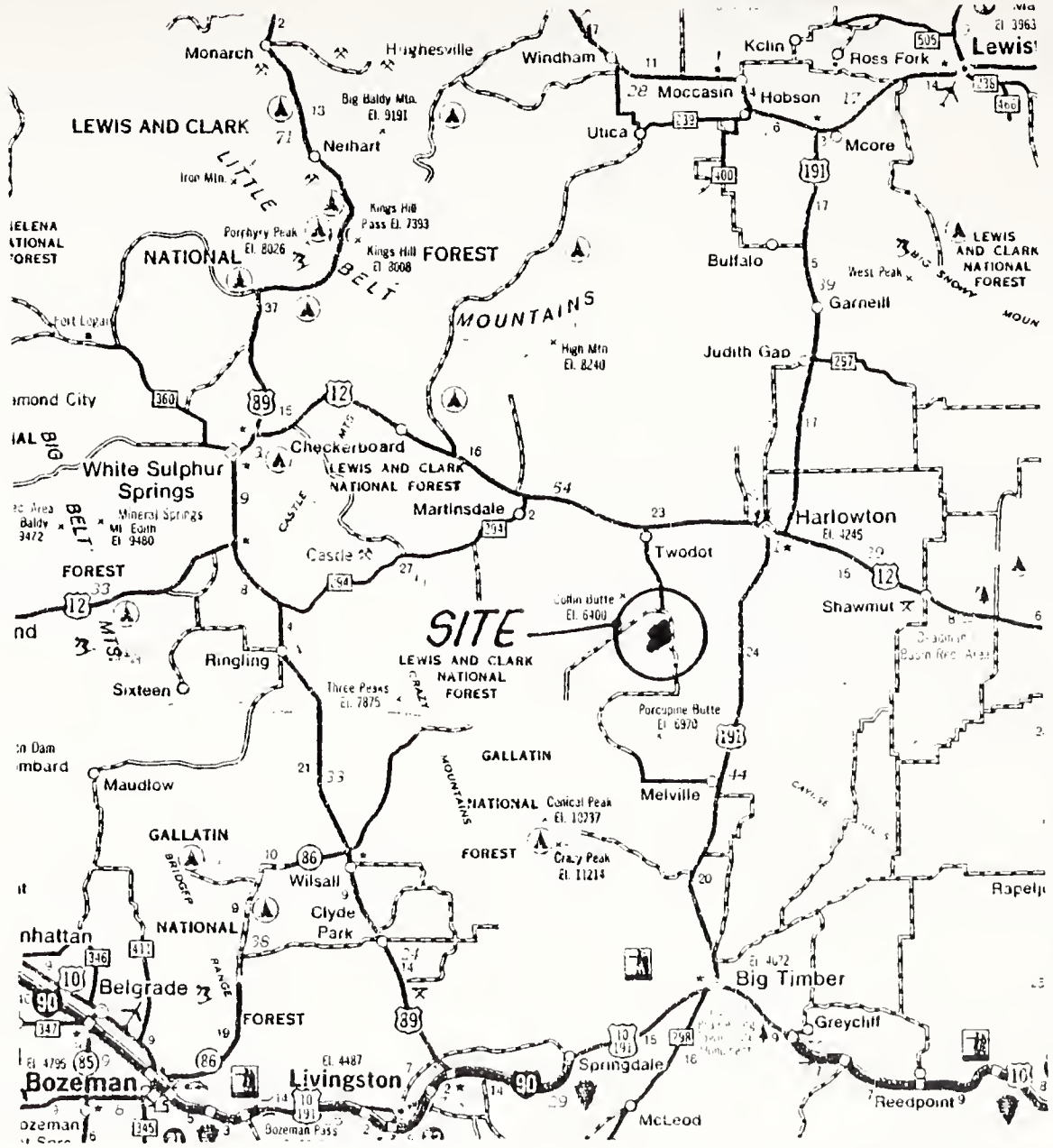
(PHOTO 14) Dam 3, upper slope of downstream face.

(PHOTO 15) Dam 3, outlet and lower slope of downstream face.

(PHOTO 16) Looking downstream from the crest of Dam 3.



SITE PLAN



VICINITY MAP

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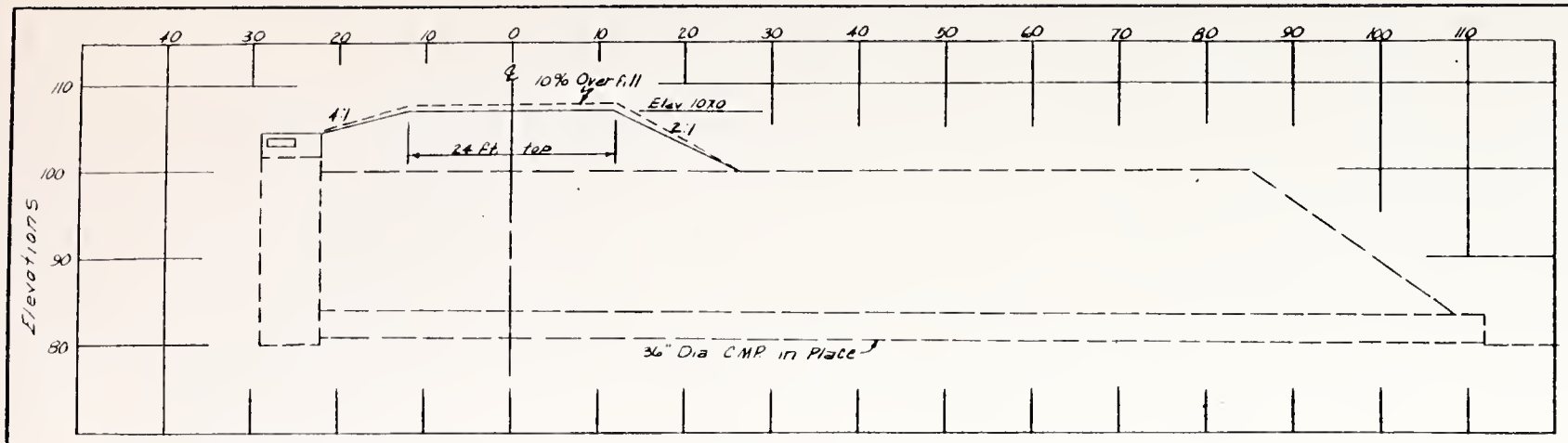
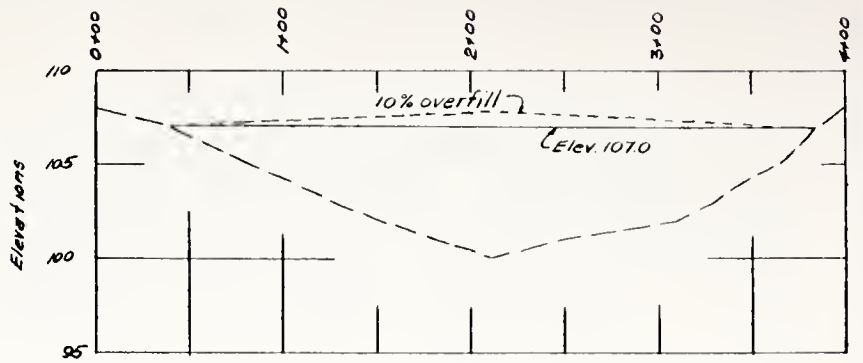
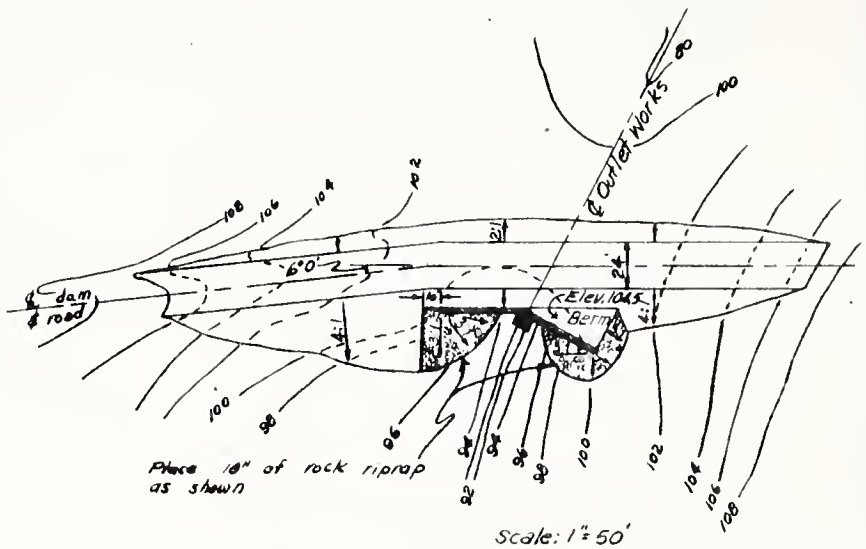
PLATE 1

LEBO LAKE AND DAMS
SITE PLAN & VICINITY MAP

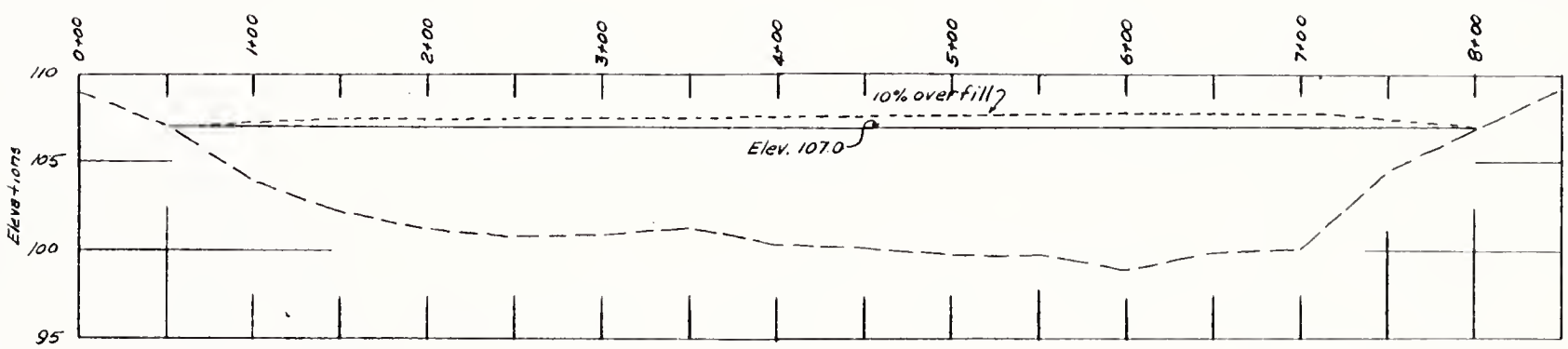


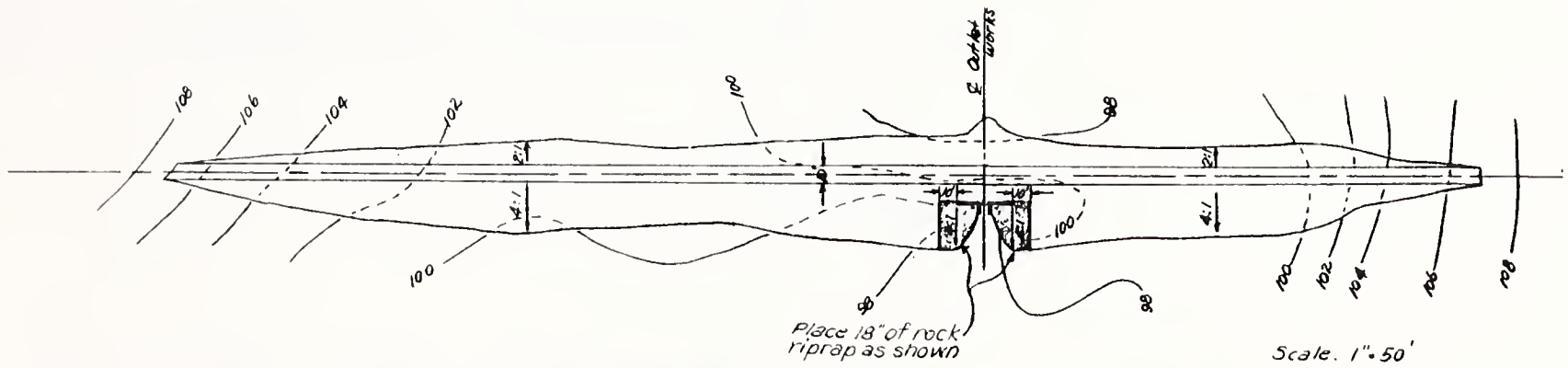
Note: These Plans Are For Raising The Existing Dams In 1969. These Are Not As-Built Drawings. Actual Conditions Differ Somewhat. See Text.





MAIN DAM, OUTLET WORKS, AND PRIMARY SPILLWAY (Dam 3)





NORTH-EAST DAM AND OUTLET WORKS (Dam 2)

Not To Scale
Reduced From Original Drawing.

PLATE 2

LEBO LAKE IRRIGATION STORAGE ENLARGEMENT

Wheatland County Montana

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed | Date | Approved | Title
Drawn | | | Title
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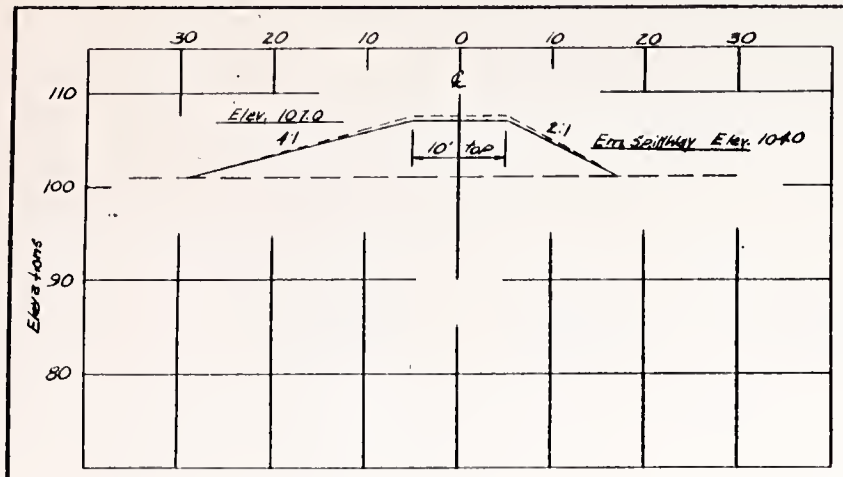
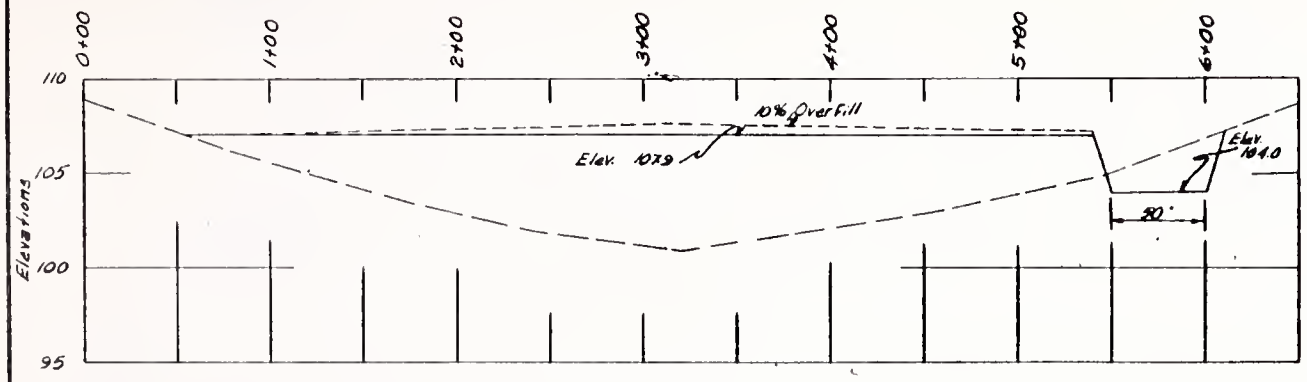
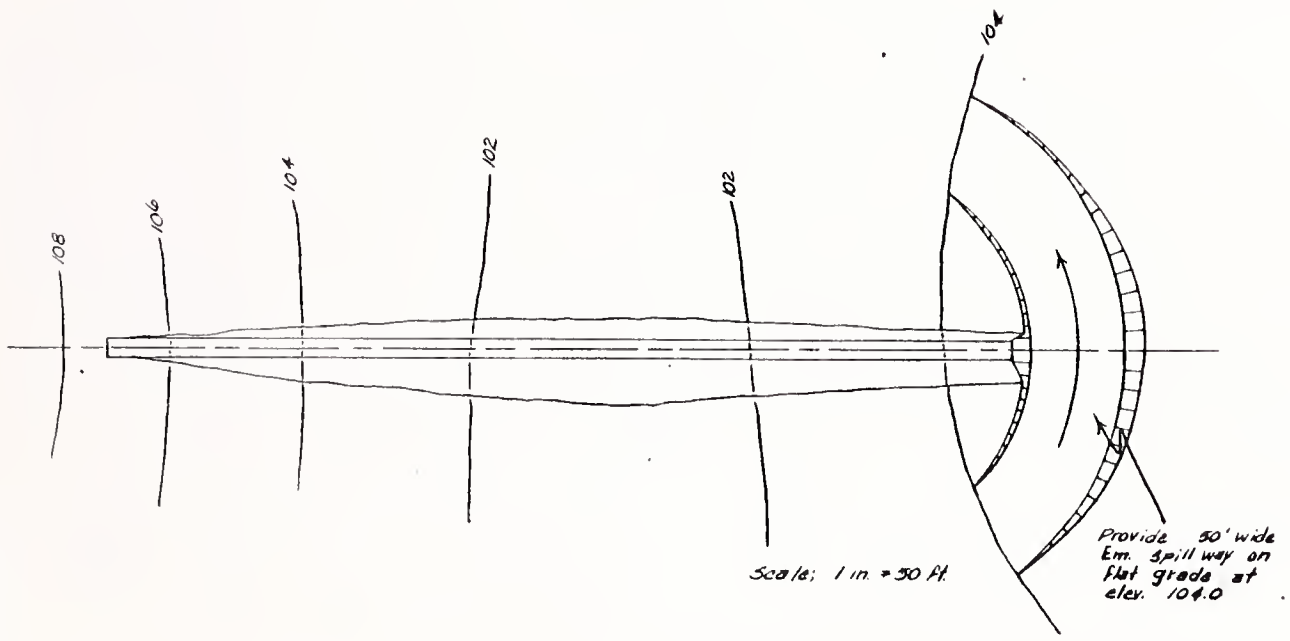
Checked







NORTH-WEST DAM & EM. SPILLWAY (Dam 1)

PLATE 3

Note: These Plans Are For Raising The Existing Dams in 1969. These Are Not As-Built Drawings. Actual Conditions Differ Somewhat. See Text.

Not To Scale
Reduced From Original Drawing.

LEBO LAKE IRRIGATION STORAGE ENLARGEMENT

Wheatland County Montana

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Date	Approved by
Designed	Title
Drawn	
Traced	Title
Checked	Sheet No. 3 of 5 sheets — Drawing No.

Surface Area (Acres)

550 500 450 400 350 300 250 200 150 100

4926
4922
4918
4914
4910

Elevation (Feet)

Elev. Vs. Vol.

Elev. Vs. S.A.

0 1000 2000 3000 4000 5000 6000 7000 8000

Volume (Acre Ft.)

Reservoir Area & Storage Curves
Lebo Lake

PLATE 4

PMP Depth - Duration Curve
Lebo Lake

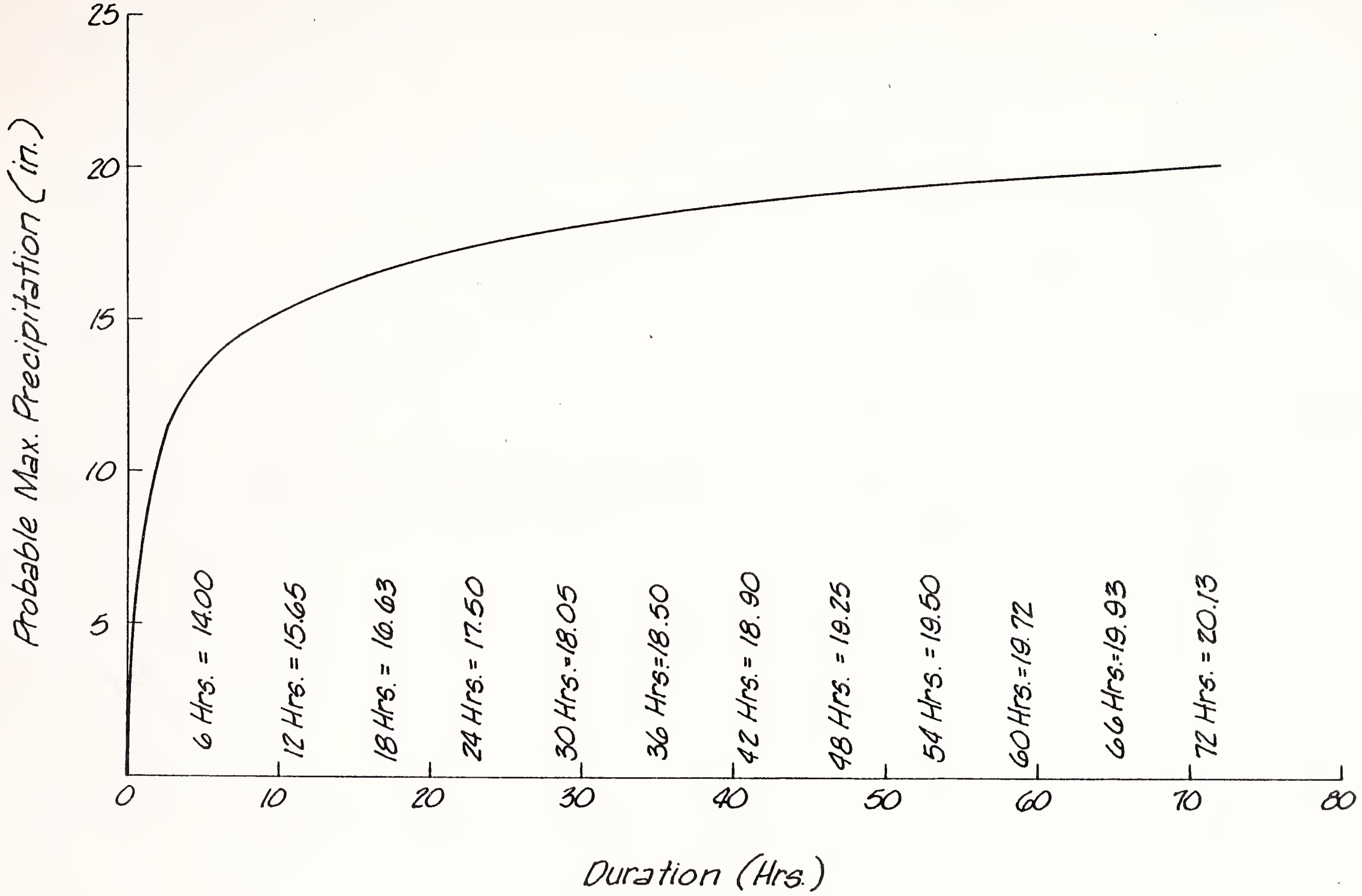


PLATE 5

Emergency Spillway Discharge Rating Curve
Lebo Lake - Dam 1

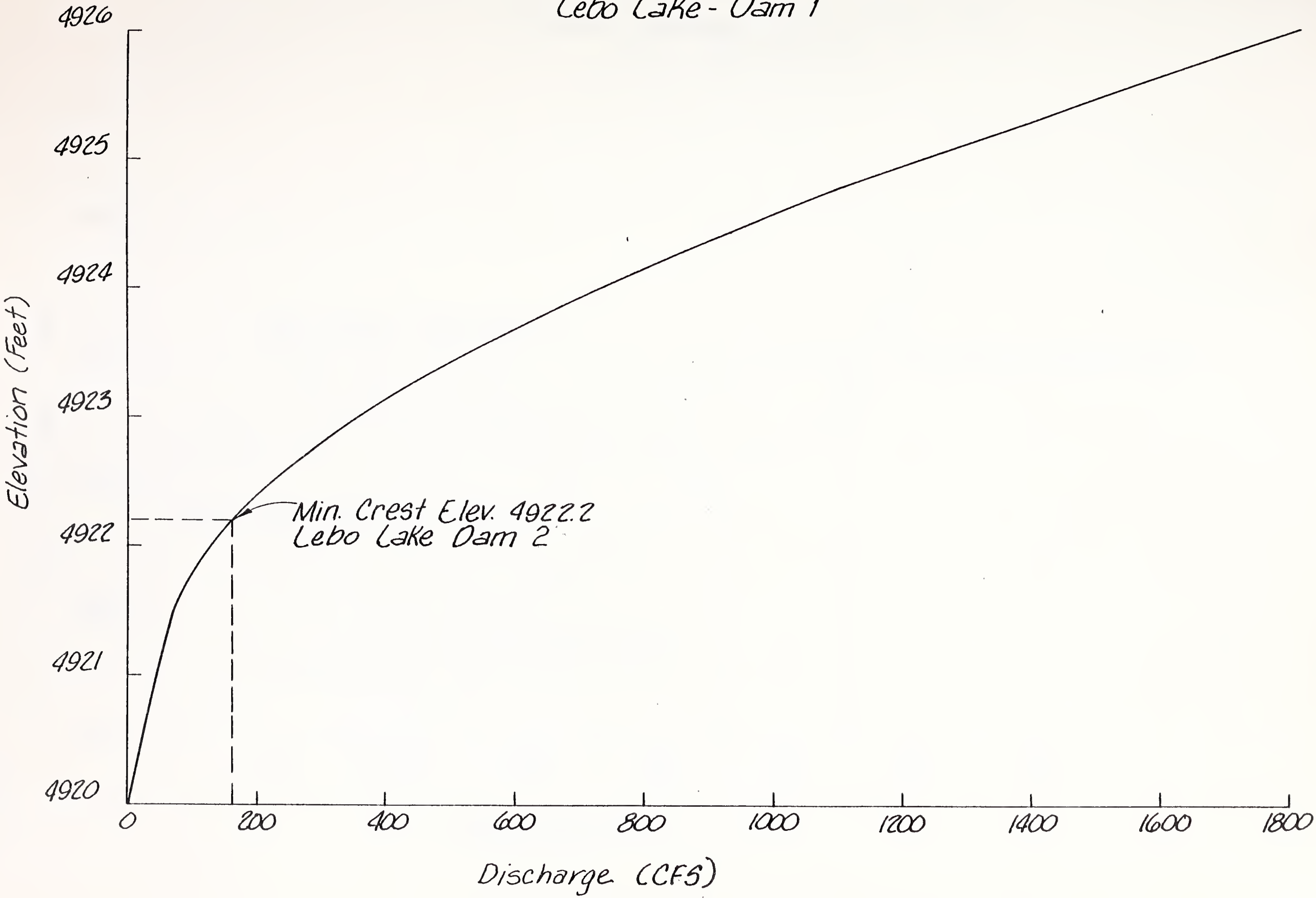


PLATE 6

Principal Spillway Discharge Rating Curve
Lebo Lake Dam 3

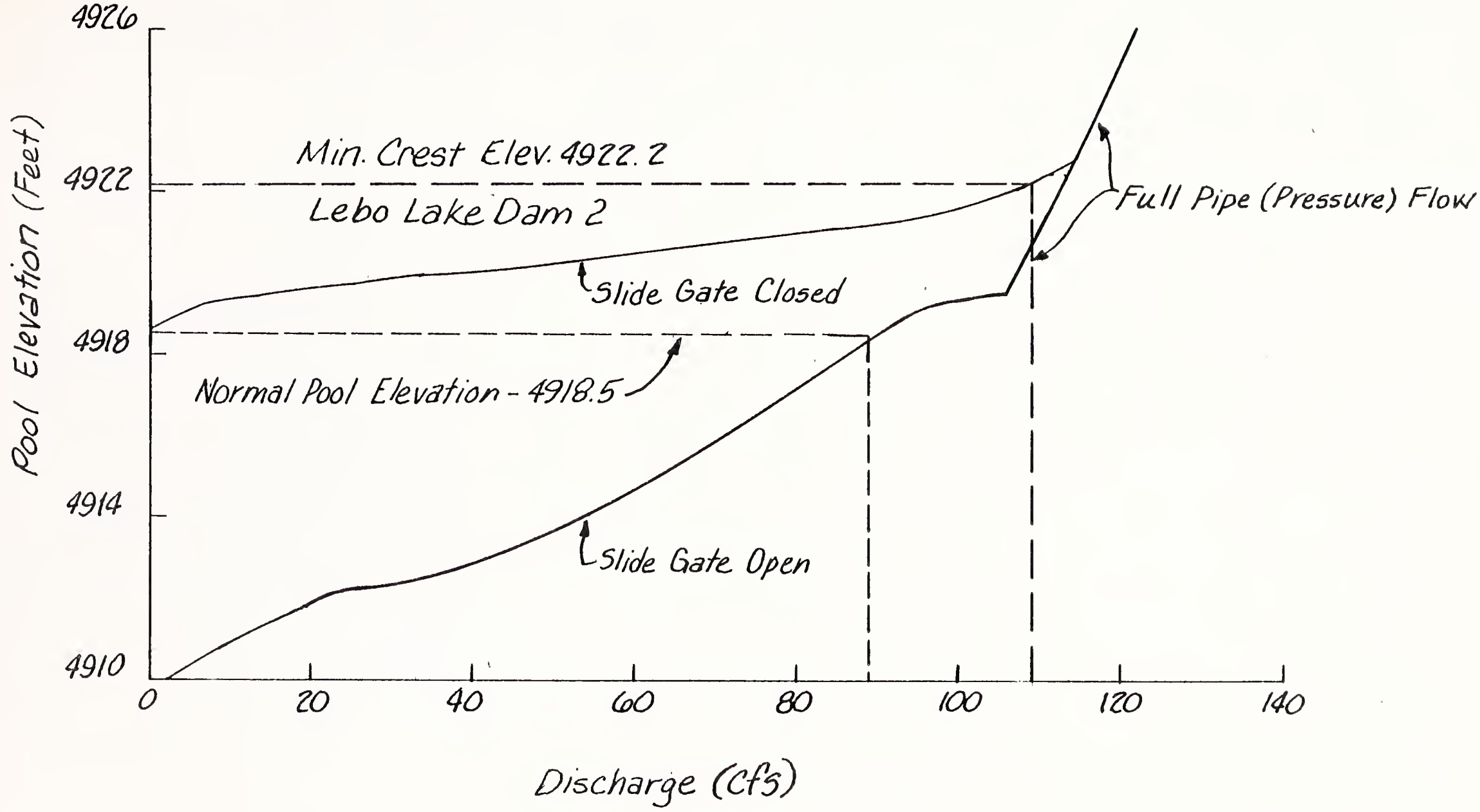


PLATE 7

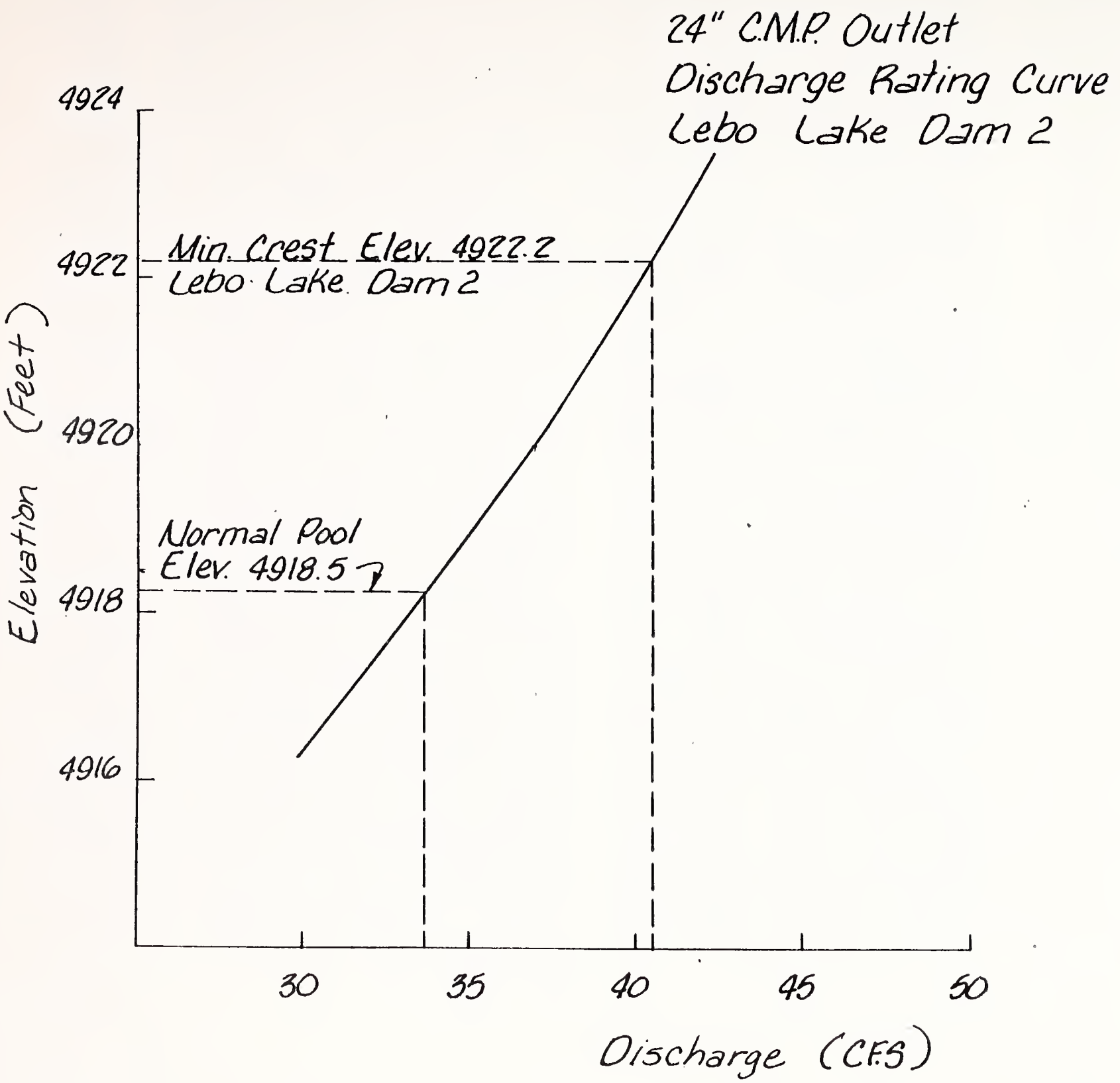

24" C.M.P. Outlet
Discharge Rating Curve
Lebo Lake Dam 2
4924
4922
Min. Crest Elev. 4922.2
Lebo Lake Dam 2
4920
Normal Pool
Elev. 4918.5
4918
4916
Elevation (Feet)
30
35
40
45
50
Discharge (C.F.S.)

PLATE 8

THE LAW FIRM
MOORE, RICE, O'CONNELL & REFLING

PERRY J. MOORE
ROBERT J. RICE
BARRY G. O'CONNELL
MARK D. REFLING
MARY LOU SCHLEGEL
DAVID R. BARNHILL

420 WEST MENDENHALL
P. O. BOX 1288
BOZEMAN, MONTANA 59715
TELEPHONE: 587-5511

20 SOUTH CENTRAL
HARLOWTON, MONTANA 59036
TELEPHONE: 632-4389

August 11, 1980

Sidney Knudson, P.E.
Asst. Chief, Engineering Division
Seattle District, Corps of Engineers
Box C-3755
Seattle, Washington 98124

Gentlemen:

Recently there was a safety inspection of Lebo Lake Dam located in Wheatland County, Montana. A report based upon the inspection was prepared and copies of the report have been provided to the owners of the dam who are American Fork Ranch and Glennie Ranches, both of which receive their mail at Two Dot, Montana. The owners were asked to respond to the report. This letter is intended as such a response.

The recommendations of most significance which are contained in the report relate in one way or another to an estimated probable maximum flood (PMF) and to the assumption that one of the dam's structures might then fail. The report then concerns itself with the damage that might then occur downstream from the dam.

The owners point out that the reports state the drainage basin carrying water to the reservoir encompasses 3.3 square miles. Any storm of the intensity of the Montana storm of June, 1964 will not be limited in its extent to that drainage basin. It will cover the upper reaches of both Big Elk Creek and American Fork Creek. The amount of water these streams would carry from such a storm would create flooding of such significance that the added amount resulting from the failure of Lebo Dam #2 could result in little, if any, additional property damage. The structures referred to as requiring classification of dam #1 and dam #2 as having high downstream hazard potential are all within the Big Elk Creek flood plain, and would suffer severe damage from the P.M.F., even if the Lebo dams hold.

This is a private irrigation project. Any warning plan must of necessity, involve more people than the owners. The civil defense program for Wheatland County has been successfully used

in the past as a means whereby upstream ranchers could notify downstream dwellers of approaching high water. The owners would, of course, utilize this system of spreading the word of high water in the event of a severe storm. They would further cooperate in any way to minimize the potential for damage through any other warning system that those in the community desire to implement.

The report indicates some engineering deficiencies in the construction of the dams. All engineering activity in recent years was conducted by the Soil Conservation Service. While some present deviation from the plans may now be evident, (dam slopes and spillway width) the construction was approved by S.C.S. engineers at the time the work was done. The owners are not engineers and their reliance upon the government agency in its professional and technical recommendations is reasonable. Further, the deficiencies noted in the report are not characterized elsewhere in the report as requiring correction.

The rodent damage noted is of concern to the owners. Unfortunately, elimination of the rodents in that localized area is nearly impossible without similar elimination over the larger surrounding area. The best and most reliable means of rodent control are prohibited by the government. With the rodent "explosion" of the past few years, the animals will repopulate a small controlled area within days and the task must then be undertaken again.

So to with brush control and removal. The owners are not allowed by the government to use effective sprays which will prevent regrowth near to fish habitat. The owners are willing, however, to undertake reasonable efforts to eliminate both rodents and brush where it is evident that structural weakness results from either. They are not willing, however, to undertake the near impossible task of eliminating either rodents or brush completely from the structures nor do they believe such an undertaking is necessary.

The principal concern would seem to be the wheel ruts on the crest of dam #2. The owners are willing to discuss with any government agency any suggestions for repair or correction. They only ask that if they accept the recommendations of one such agency they not find that another agency is criticizing those recommendations.

The owners wish to maintain the dams in a safe condition. It

is to their advantage to do so. They will continue to inspect the dams periodically, as they have in the past. If the inspections generate concern about the structures, they will seek professional advice from the S.C.S. or private engineers. If the engineers recommend specific actions to assure the safety and stability of the dams they will take such actions. The owners are willing to discuss the contents of the report and the contents of this response with representatives of any agency.

Yours truly,

Perry J. Moore mf

PERRY J. MOORE
Attorney at Law

PJM:mf

cc: Water Resources Division
Montana Dept. of Natural Resources

Col. Robert J. Stevens

Stanton Brannin

Tom Stevens

Mrs. Jane Glennie

David Niklas, Esq.

DEPARTMENT OF NATURAL RESOURCES
AND CONSERVATION
WATER RESOURCES DIVISION

THOMAS L. JUDGE, GOVERNOR

32 SOUTH EWING

STATE OF MONTANA

(406) 449-2872

HELENA, MONTANA 59601

June 20, 1980

Ralph Morrison
Department of the Army
Seattle District, Corps of Engineers
P.O. Box C-3755
Seattle, Washington 98124

Dear Ralph:

The Department of Natural Resources and Conservation has reviewed the final draft report on the Lebo Lake Dams (MT-72), (MT-653), and (MT-73). We concur with the findings and recommendations and feel that the report satisfies the criteria for the Phase I evaluation. Minor comments have been discussed with your staff and we understand that these will be included in the final report.

Thank you for this opportunity to review and comment on the final draft report for this project.

Sincerely,

Richard L Bondy

Richard L. Bondy, P.E.
Chief, Engineering Bureau
(406) 449-2864

RB/LT/mb

AN EQUAL OPPORTUNITY EMPLOYER

United States Department of Agriculture
Soil Conservation Service
P.O. Box 970
Bozeman, MT
59715

June 27, 1980

Sidney Knutson, P.E.
Assistant Chief
Engineering Division
Seattle District, Corps of Engineers
P.O. Box C-3755
Seattle, WA 98124

Dear Mr. Knutson:

Thank you for the opportunity to review the final draft report on the Lebo Lake Dams (MT-72, MT-73, and MT-653).

As far as can be determined SCS involvement was minimal. The reproduced plans for raising the dams are the only records known to exist. It is not known to us whether or not the actual 1969 construction was done under SCS guidance.

We cannot agree with the hydrology criteria used to develop the probable maximum flood.

Sincerely,

Wallace K Holly for

Van K Haderlie
State Conservationist

cc:
Homer Moore, State Conservation Engineer, SCS, Bozeman
Dave Jones, Environmental Engineer, SCS, Bozeman